

What is claimed is:

1. A sports simulation system comprising:
 - a projectile tracking apparatus including a display surface on which a visually apparent three-dimensional sports scene is presented, said projectile tracking apparatus capturing images of a projectile tracking region disposed in front of said display surface to detect a launched projectile traveling through said projectile tracking region towards said display surface; and
 - at least one processing stage receiving the image data and determining the three-dimensional positions, velocity and deceleration/acceleration of a detected projectile traveling through said projectile tracking region, the three-dimensional positions, velocity and deceleration/acceleration being used by said at least one processing stage to calculate a trajectory of said launched projectile into said visually apparent three-dimensional sports scene.
- 15 2. A sports simulation system according to claim 1 wherein said at least one processing stage uses said calculated trajectory to generate updated image data including a simulation of said launched projectile into said visually apparent three-dimensional sports scene following said calculated trajectory.
- 20 3. A sports simulation system according to claim 2 further comprising a display device coupled to said at least one processing stage, said display device receiving image data from said at least one processing stage and presenting said visually apparent three-dimensional sports scene including said simulation on said display surface.
- 25 4. A sports simulation system according to claim 3 wherein said visually apparent three-dimensional scene includes at least one foreground action element overlying and moveable over a background image, said at least one processing stage updating said image data so that said at least one foreground action element responds to the simulation of said launched projectile.

5. A sports simulation system according to claim 3 wherein said projectile tracking apparatus includes a frame and at least one pair of imaging devices mounted on said frame, said imaging devices having overlapping fields of view looking across and in front of said display surface and capturing images of said projectile tracking region.
- 10 6. A sports simulation system according to claim 5 wherein said imaging devices have generally perpendicular fields of view looking across and in front of said display surface from adjacent opposite corners of said frame.
- 15 7. A sports simulation system according to claim 6 wherein said frame encompasses a rectangular region and wherein said projectile tracking apparatus includes four imaging devices, each having a field of view looking across and in front of said display surface from a different corner of said rectangular region, said fields of view overlapping in a generally perpendicular manner.
- 20 8. A sports simulation system according to claim 7 wherein said visually apparent three-dimensional scene includes at least one foreground action element overlying and moveable over a background image, said at least one processing stage updating said image data so that said at least one foreground action element responds to the simulation of said launched projectile.
- 25 9. A sports simulation system according to claim 6 wherein each of said imaging devices includes a first processor constituting one processing stage, each said first processor generating two-dimensional projectile position data as said projectile travels through said projectile tracking region, said two-dimensional projectile position data being conveyed to a host processor constituting a second processing stage, said host processor using the two-dimensional projectile position data received from each first processor to generate three-dimensional projectile position data and to calculate the velocity and deceleration/acceleration of said projectile.
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10. A sports simulation system according to claim 9 wherein each said first processor examines captured images to detect pixel clusters resembling a characteristic projectile signature thereby to detect said projectile in said captured images.

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11. A sports simulation system according to claim 9 further including an audio system to broadcast audio accompanying said visually apparent three-dimensional sports scene and simulation.

10 12. A sports simulation system according to claim 3 wherein said at least one processing stage executes sports simulation software including at least two of a training mode, a practice mode and a game play mode, the visually apparent three-dimensional sports scene being consistent with the selected mode.

15 13. A sports simulation system according to claim 12 wherein said sports simulation software includes a plurality of selectable sports modules each relating to a different sport that can be simulated, each sports module including at least two of a training mode, a practice mode and a game play mode.

20 14. A sports simulation system according to claim 13 wherein said sports modules include a football module, a soccer module, a hockey module, a baseball module and a golf module.

25 15. A sports simulation system according to claim 10 wherein said host processor executes sports simulation software including at least two of a training mode, a practice mode and a game play mode, the visually apparent three-dimensional sports scene being consistent with the selected mode.

30 16. A sports simulation system according to claim 15 wherein said sports simulation software includes a plurality of selectable sports modules each relating to a different sport that can be simulated, each sports module including at least two of a training mode, a practice mode and a game play mode.

17. A sports simulation system according to claim 16 wherein said sports modules include a football module, a soccer module, a hockey module, a baseball module and a golf module.

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18. A sports simulation system according to claim 17 further including an audio system to broadcast audio accompanying said visually apparent three-dimensional sports scene and simulation.

10 19. A sports simulation system according to claim 4 wherein said visually apparent three-dimensional sports scene includes a plurality of foreground action elements independently moveable over said background image.

15 20. A sports simulation system according to claim 4 wherein said at least one foreground action element, background image and launched projectile simulation are non-destructive overlay image planes that are combined seamlessly to complete said visually apparent three-dimensional sports scene.

21. A sports simulation system according to claim 19 wherein said 20 foreground action elements, background image and launched projectile simulation are non-destructive overlay image planes that are combined seamlessly to complete said visually apparent three-dimensional sports scene.

22. A sports simulation system comprising:
25 a projectile tracking apparatus including a frame encompassing a display surface on which a video sequence portraying a visually apparent three-dimensional sports scene is presented; at least one pair of digital cameras mounted on said frame and having fields of view looking across and in front of said display surface that overlap in a generally perpendicular fashion and encompassing a projectile tracking region, each of said digital cameras including a first processor for processing image data and generating two-dimensional projectile coordinates when a projectile travels through said projectile tracking region and is captured in images

acquired by said digital cameras; and an audio system to broadcast audio accompanying said video sequence;

- 5 a host processor communicating with said digital cameras and said audio system, said host processor calculating a three-dimensional trajectory of said projectile using the two-dimensional projectile coordinates received from each first processor and outputting image data including said calculated three-dimensional trajectory; and

10 a display unit receiving said image data and presenting said video sequence including a simulation of said calculated trajectory on said display surface.

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23. A sports simulation system according to claim 22 wherein said visually apparent three-dimensional scene includes at least one foreground action element overlying and moveable over a background image, said host processor updating said image data so that said at least one foreground action element responds to the 15 calculated trajectory of said projectile.

24. A sports simulation system according to claim 23 wherein said frame is readily assembled and disassembled

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25. A sports simulation system according to claim 23 wherein said host processor executes sports simulation software including at least two of a training mode, a practice mode and a game play mode, the visually apparent three-dimensional sports scene being consistent with the selected mode.

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26. A sports simulation system according to claim 25 wherein said sports simulation software includes a plurality of selectable sports modules each relating to a different sport that can be simulated, each sport module including at least two of a training mode, a practice mode and a game play mode.

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27. A sports simulation system according to claim 26 wherein said sports modules include a football module, a soccer module, a hockey module, a baseball module and a golf module.

28. A sports simulation system according to claim 22 wherein each said first processor examines captured images to detect pixel clusters resembling a characteristic projectile signature thereby to detect said projectile in said captured 5 images.
29. A sports simulation system according to claim 28 wherein said frame encompasses a rectangular region and wherein said projectile tracking apparatus includes four imaging devices, each having a field of view looking across and in front 10 of said display surface from a different corner of said rectangular region, said fields of view overlapping in a generally perpendicular manner.
30. A sports simulation system according to claim 23 wherein said visually apparent three-dimensional sports scene includes a plurality of foreground action 15 elements independently moveable over said background image.
31. A sports simulation system according to claim 23 wherein said at least one foreground action element, background image and launched projectile simulation are non-destructive overlay image planes that are combined seamlessly to complete 20 said visually apparent three-dimensional sports scene.
32. A sports simulation system according to claim 30 wherein said foreground action elements, background image and launched projectile simulation are non-destructive overlay image planes that are combined seamlessly to complete said 25 visually apparent three-dimensional sports scene.
33. A sports simulation system according to claim 23 wherein each said first processor examines captured images to detect pixel clusters resembling a characteristic projectile signature thereby to detect said projectile in said captured 30 images.

34. A sports simulation system according to claim 33 wherein said visually apparent three-dimensional sports scene includes a plurality of foreground action elements independently moveable over said background image.
- 5 35. A sports simulation system according to claim 34 wherein said foreground action elements, background image and launched projectile simulation are non-destructive overlay image planes that are combined seamlessly to complete said visually apparent three-dimensional sports scene.
- 10 36. A projectile tracking apparatus for a sports simulation system comprising:
a frame encompassing a display surface on which a video sequence portraying a visually apparent three-dimensional sports scene is presented;
at least one pair of digital cameras mounted on said frame and having
15 fields of view looking across and in front of said display surface that overlap in a generally perpendicular fashion and encompassing a projectile tracking region, each of said digital cameras including a processor for processing image data and generating two-dimensional projectile coordinates when a projectile travels through said projectile tracking region and is captured in images acquired by said digital cameras;
20 and
an audio system to broadcast audio accompanying said video sequence.
37. A projectile tracking apparatus according to claim 36 wherein each said processor stores a projectile characteristic signature that is compared with
25 captured images to detect the presence of a projectile therein.
38. A projectile tracking apparatus according to claim 37 wherein said frame encompasses a rectangular region and wherein said projectile tracking apparatus includes four imaging devices, each having a field of view looking across
30 and in front of said display surface from a different corner of said rectangular region, said fields of view overlapping in a generally perpendicular manner.

39. A projectile tracking apparatus according to claim 38 further comprising a mirror associated with each digital camera to direct the field of view thereof across and in front of said display surface.